THE BEDROCK TOPOGRAPHY OF SCIOTO TOWNSHIP, PICKAWAY COUNTY, OHIO

A Thesis

Presented in Partial Fulfillment of the Requirements
for the Degree Bachelor of Science

by

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Approved by

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Mineralogy

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Finally, I would like to thank fellow undergraduates in Geology at Ohio State for their many suggestions which aided in the completion of this report.

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Location and Purpose

Pickaway County is located in south-central Ohio (Fig. 1). It is bounded on the north by Franklin County, on the east by Fairfield and Hocking Counties, on the south by Ross County, and on the west by Fayette and Madison Counties.

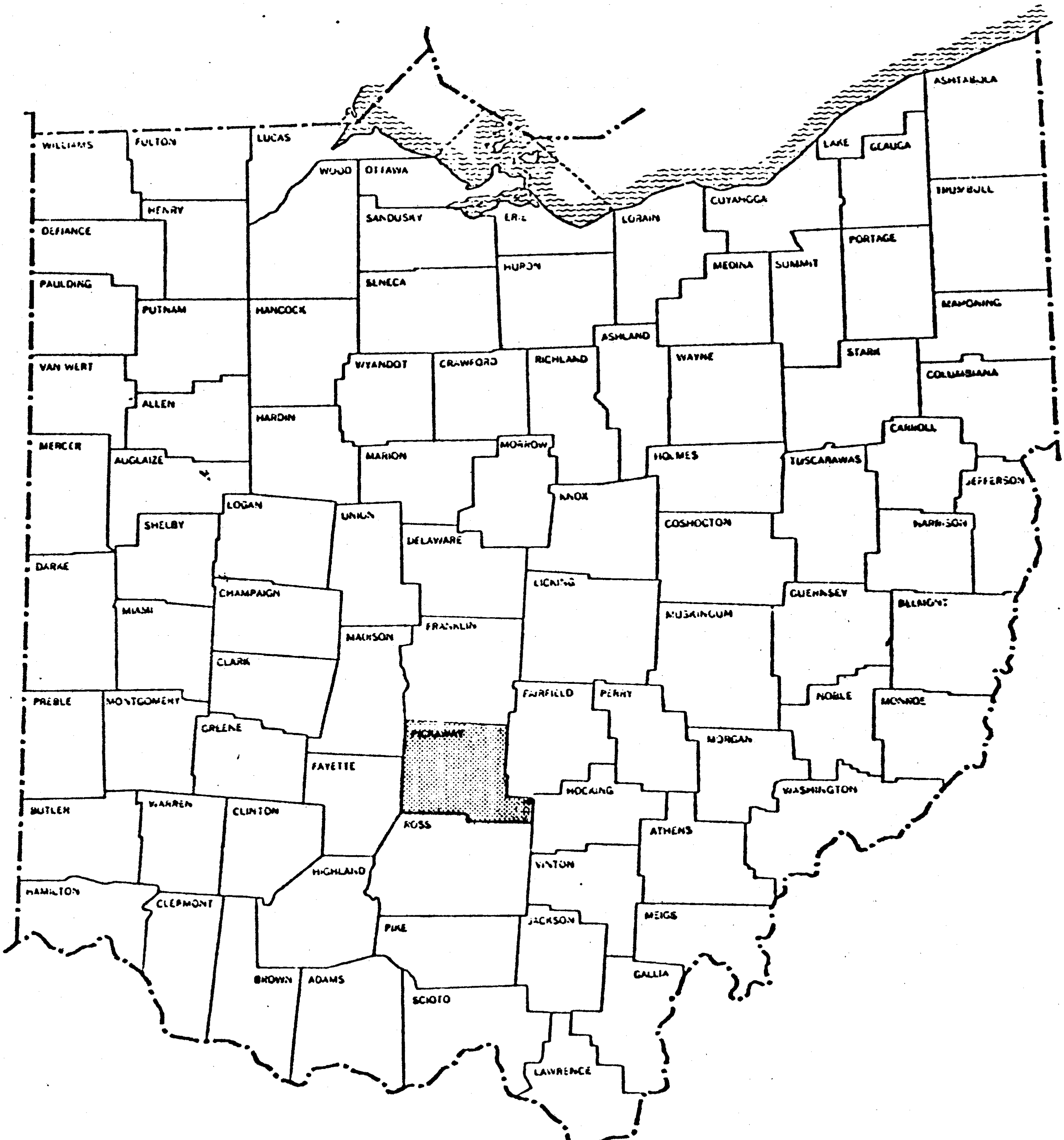
Scioto Township, the map area, is located in north-central Pickaway County (Fig. 2).

The purpose of this project was to map as precisely as current data will allow the buried bedrock topography of the study area, and discuss the events that have helped shape the old surface.

Geology of Scioto Township

Pickaway County lies on the eastern limb of the Cincinatti Arch and beds dip approximately 30 ft/mi. toward the east. Based on well records, the bedrock underlying Scioto Township is most likely the Devonian Columbus Limestone. In some deeper wells to the west, it appears the Silurian Bass Island Group also is exposed beneath the till. To well drillers, these together are known as the "Big Lime". Outcrops of these limestones, or bedrock in general, are not known in the township.

Drift in Scioto Township ranges in thickness from greater than 200 feet along the buried channels to as little as 5-10 feet near Orient. Overall, the till and alluvium averages greater than 100 feet in the area. A map of the Glacial Deposits of Ohio is included to show the extent of Ohio's drift mantle (Fig. 3).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PUTNAM
HANCOCK
SENECA
HURON
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PORTAGE
ASHLAND
VAN WERT
WYANDOT
CRAWFORD
RICHLAND
WAYNE
STARK
COLUMBIANA
ALLEN
HARDIN
MERCER
AUGLAIZE
MARION
MORROW
HOLMES
TUSCARAWAS
CARROLL
JEFFERSON
LOGAN
SHELBY
UNION
KNOX
DELAWARE
COSHOCTON
DARKE
CHAMPAIGN
LICKING
GUERNSEY
MIAMI
MUSKINGUM
MADISON
FRANKLIN
CLARK
PREBLE
MONTGOMERY
FAIRFIELD
PERRY
NOBLE
MONROE
GREENE
MORGAN
FAYETTE
HOCKING
WASHINGTON
BUTLER
WARREN
CLINTON
ROSS
ATHENS
HIGHLAND
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CLERMONT
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LAWRENCE

Figure 1

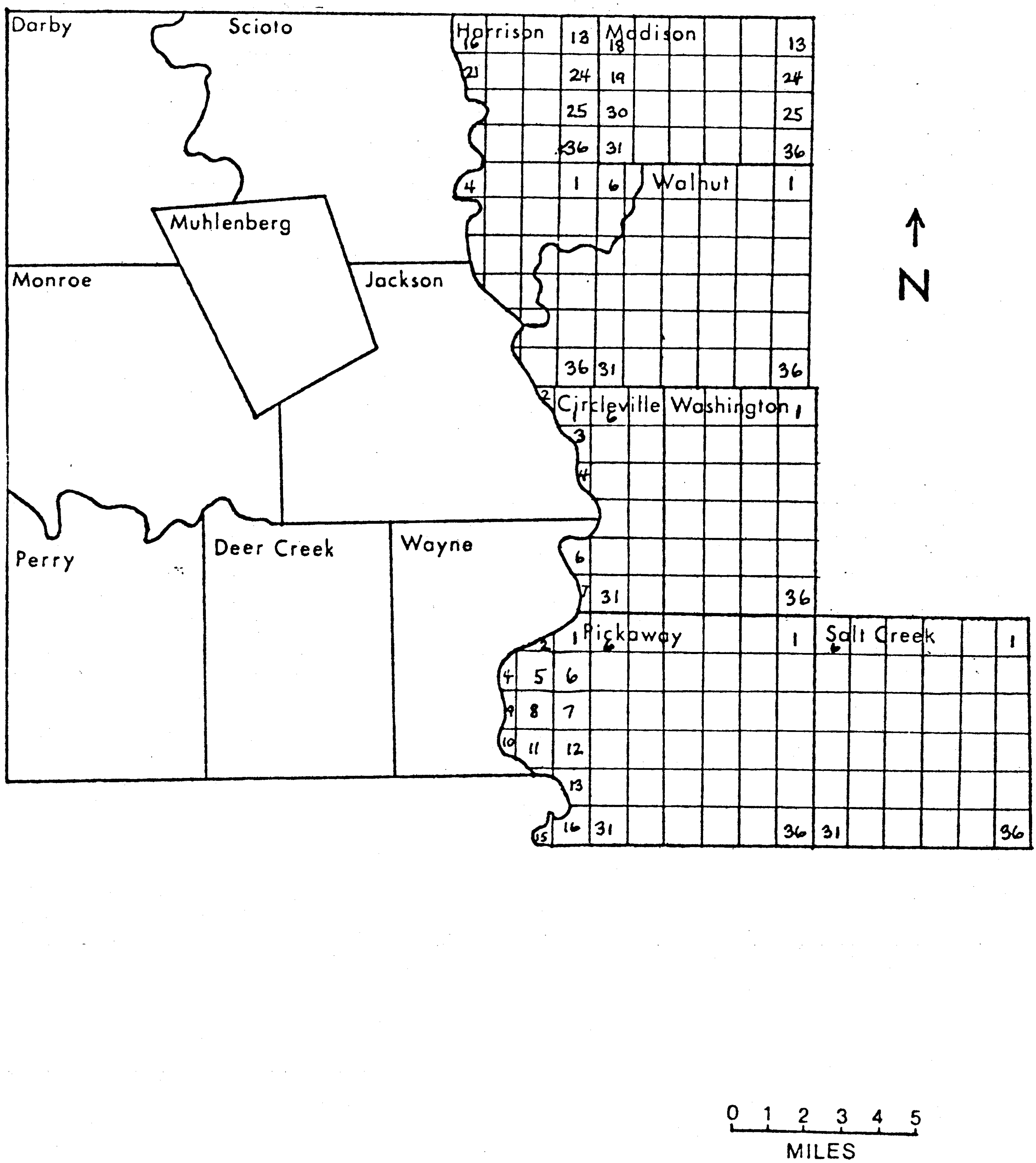
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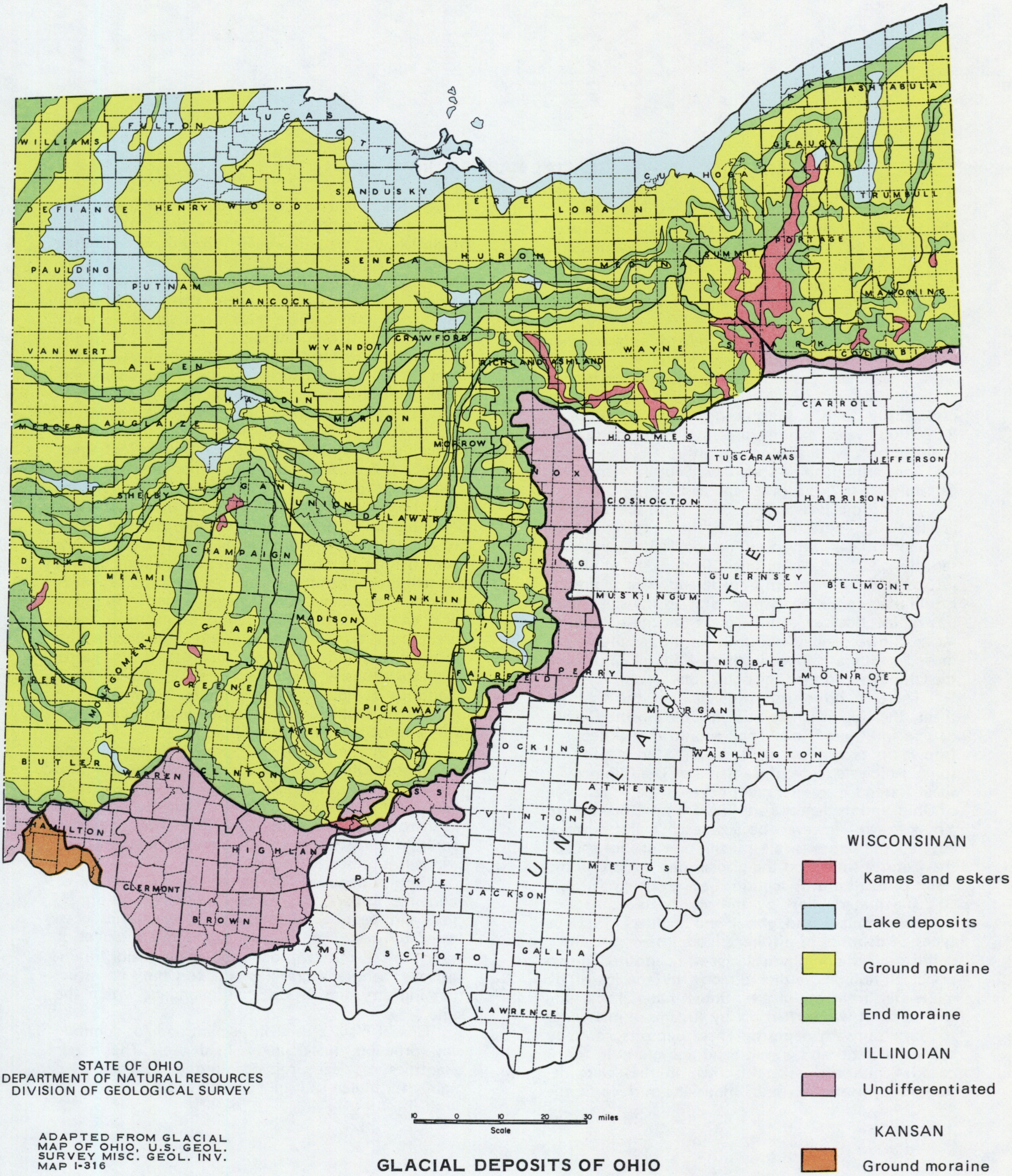
Figure 2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KNOX
HOLMES
CARROLL
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LOGAN
UNION
DELAWARE
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GUERNSEY
BELMONT
DARKE
MIAMI
CHAMPAIGN
FRANKLIN
MADISON
CLARK
PREBLE
MONTGOMERY
GREENE
FAIRFIELD
PERRY
NOBLE
MONROE
MORGAN
PICKAWAY
FAYETTE
HOCKING
WASHINGTON
ATHENS
BUTLER
WARREN
CLINTON
ROSS
VINTON
MEIGS
HAMILTON
HIGHLAND
PIKE
JACKSON
CLERMONT
BROWN
ADAMS
SCIOTO
GALLIA
LAWRENCE
UNGLACIATED
WISCONSINAN
Kames and eskers
Lake deposits
Ground moraine
End moraine
ILLINOIAN
Undifferentiated
KANSAN
Ground moraine
STATE OF OHIO
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL SURVEY
ADAPTED FROM GLACIAL MAP OF OHIO, U.S. GEOL. SURVEY MISC. GEOL. INV. MAP I-316
10 0 10 20 30 miles
Scale
GLACIAL DEPOSITS OF OHIO

Figure 3

GLACIAL MAP OF OHIO

Although perhaps difficult to imagine, Ohio at one time had almost three-quarters of its surface area covered by vast sheets of ice perhaps as much as one mile thick. Ohio has, in fact, been partially covered by great ice sheets at least three and possibly four times in the recent (within the last few million years) geologic past.

Evidence in the geologic record suggests that periods of extensive glaciation extend far into the world's geologic past. The most recent period of glaciation and one which is evident in Ohio is known geologically as the Pleistocene Epoch (11,000 to 2,000,000 years before present). This period of geologic history is also commonly referred to as the Ice Age, although, as stated previously, there were certainly other "ice ages" in the past.

During the Pleistocene, four major ice advances are known to have occurred on the North American continent. These advances, named Nebraskan, Kansan, Illinoian, and Wisconsinan, from oldest to youngest, came from northern Canada and were the result of climatic conditions which allowed massive buildups of ice. Because of their great thickness these ice masses flowed under their own weight and ultimately moved south as far as northern Kentucky, crossing the Ohio River in the Cincinnati area.

There is no direct evidence that the first ice sheet, the Nebraskan, occupied Ohio. In the Cincinnati region there is one small area of glacial deposits (shown in brown on map) which is considered by some geologists to be of Kansan age. The Illinoian ice sheet (lavender area on map) covered the largest area of Ohio, and its deposits are found from Cincinnati to Youngstown. However, because each major advance covered the deposits left by the previous ice sheets, the features shown on the glacial map are largely the result of the last or Wisconsinan-age glaciers.

The material left by the ice sheets consists of mixtures of clay, sand, gravel, and boulders in various types of deposits of different modes of origin. Rock debris carried along by a glacier was deposited in two principal fashions, either directly by the ice or by meltwater from the glacier. Some material reaching the ice front was carried off by streams of meltwater to form outwash deposits. These deposits normally consist of sand and gravel. Sand and gravel in forms called kames and eskers (shown in red) were deposited by water on and under the surface of the glacier itself and are recognized by characteristic shapes and composition. The distinctive characteristic of glacial debris that has been moved by water is that it was sorted by the water which carried it off. The larger boulder-size particles were left behind while the smaller clay-size particles were carried far away, leaving the intermediate gravel- and sand-size materials along the stream courses.

Boulder- to clay-size material deposited directly from the ice was not sorted. Some of the debris was deposited as ridges parallel to the edge of the glacier itself, forming a terminal or end moraine (shown on map in dark green), which marks the position of the retreating ice when it paused for a period of time, possibly a few hundred years. When the entire ice sheet receded because of melting, much of the ground-up rock material still held in the ice was deposited on the surface as ground moraine (light green on map). The term glacial drift is commonly used to refer to any material deposited at or behind the terminal edge of a glacier. Because the ice which invaded Ohio came from Canada, it carried in many rock types not found in Ohio. Boulders of these foreign rock types are called erratics. Rock collecting in areas covered with glacial drift or in glacial outwash deposits may yield granite, gneiss, trace quantities of gold, and, very rarely, diamonds. The bulk of the rocks found in glacial deposits, however, will be those types native to Ohio.

Many glacial lakes were formed during the time ice covered Ohio. Lake deposits (shown in blue) are primarily very fine-grained clay- and silt-size sediments. The most extensive area of lake deposits is in northern Ohio bordering Lake Erie. These deposits represent early stages in the development of Lake Erie as it is presently known.

Certain deposits left behind by the ice are of economic importance, particularly sand and gravel, clay, and peat. Sand and gravel, which has been sorted by meltwater, is generally found as kames or eskers or as outwash deposits along major drainageways. Sand and gravel is vital to Ohio's construction industry and deposits are abundant within the state.

Glacial clay is used in cement and for common clay products (particularly field tile). The minor quantities of peat produced in the state are used mainly for mulch and soil conditioning.

The Pleistocene Epoch

Northern North America has undergone widespread glaciation four times within the past million years. The glacial stages (underlined) and their corresponding interglacial stages have been named, from oldest to youngest: Nebraskan, Aftonian, Kansan, Yarmouth, Illinoisan, Sangamon, and Wisconsin. Using dating methods employing depth of leaching, degree of soil development, and radioactive carbon (C^{14}), it has been estimated that the Kansan stage ended about 600,000 years ago, the Illinoian stage about 200,000 years ago, and the Wisconsin stage less than 15,000 years ago (Kay, 1931) (Flint, 1957).

In Pickaway County, there has been no evidence found, in the form of tills, outwash, or other glacial deposits, that would indicate that Nebraskan or Kansan glaciation extended this far into Ohio. Since only Wisconsin drift is exposed within Pickaway County, the idea that this area was subjected to earlier Pleistocene glaciation is based on indirect evidence and evidence in adjacent counties. It has been inferred from the system of buried valleys in the county that this area was at least closely related to Nebraskan and Kansan glaciation. It can be assumed that Illinoian glaciation occurred in Pickaway County since a band of Illinoian drift has been mapped extending beyond the terminal moraine of the Wisconsin glaciation.

Teays Drainage System

South of the Pleistocene glacial border, and best seen in West Virginia, are abandoned valleys that bear little or no relation to much of the current drainage. They are described by Tight (1903):

> These valleys are the remnants of a very mature drainage system. In general, they are cut to depths of about 150 to 250 feet below the level of the uplands and, in places, are as much as 150 feet above the present streams.

The valleys floors are flat and well graded and when correlated together, they form a dendritic system. They were produced as the result of normal stream erosion, most likely before the Pleistocene (Tight, ibid). This valley system, commonly known as the Parker Strath, was abandoned when the drainage system was deflected by one or more of the glacial advances, which forced the streams to create new channels (Stout & Lamb, 1938).

The Teays River originated east of the Blue Ridge escarpment in the Piedmont Plateau of Virginia and North Carolina. The elevation of an extensive peneplain, known as the Lexington, caused the renewed downcutting and subsequent formation of this drainage system. The Teays River, named from a deserted valley segment in Cabell and Putnam Counties, West Virginia, was the major river occupying this old drainage system.(Tight, 1903). In a broader sense, the term "Teays" is used to indicate the work done by erosion in Ohio prior to glaciation. The term is applied to the large stream and its tributaries, but also to the work done by all of the streams contemporary with it (Ver Steeg, 1946).

From its headwaters in the Piedmont Plateau of Virginia and North Carolina, it flowed northward to White Sulphur Springs, Virginia, then northeast across the mountains to Charleston, West Virginia. Its course was the broad Teays Valley from Charleston, flowing past St. Albans, Milton, and Barboursville to the valley of the Ohio River at Huntington, West Virginia. From here it followed much the same course as the present Ohio River, to Wheelersberg, Ohio, where the course of the Teays turns abruptly northward. From Wheelersberg, it followed the path of this winding valley north to Waverly (Leverett, 1897). The Teays continued north to Chillicothe and here disappears beneath the glacial drift.

Beneath the shroud of glacial drift the exact course of the Teays is still open to much speculation. Tight (1894) assumed the Teays River flowed northward from Chillicothe to a point in central Pickaway County where he thought it joined a large tributary and continued north-westward through Madison, Clark, and Champaign Counties to the Indiana state line in Mercer County. Leverett (1897) suggested three possible courses, in addition to Tights, for the Teays below Waverly. These are:

1. Southward down the Scioto from Waverly to the Ohio and thence down the Ohio.

2. Northward along the axis of the Ohio Basin to Lake Erie.

3. Northeastward past the Licking Resevoir and along the old valley to the Muskingum at Dresden, thence northward along or near the present valleys of the Muskingum, Tuscarawas, and Cuyahoga to Lake Erie at Cleveland.

It must be kept in mind that few well records were available to Tight and Leverett at the time of the writing of their articles.

Using well records, Stout, Ver Steeg, and Lamb (1943) in their report on the Geology of Water in Ohio, roughly traced the path of the Teays main channel northwestward across Ohio to the Indiana state line (Fig. 4). From Chillicothe they believed it flowed northwestward past Andersonville and Clarksburg in Ross County, Atlanta in southwest Pickaway County, Waterloo in northeast Fayette County, London in southwest Madison County to Vienna. The Groveport River of Teays time joins the main stream here. This, according to their report, was a large tributary that drained much of Central Ohio. From this junction, the Teays River flowed westward past Bowlusville in Clark County, St. Paris in Champaign County, Pemberton, Port Jefferson, and Botkins in Shelby County, and continued more or less northwest through Auglaize, and Mercer Counties to the Indiana state line.

Fidlar (1943) has traced the course of the Teays from the Ohio - Indiana border, using thousands of well logs. From the border he believes the Teays flowed generally westward to the site of the present Wabash River. From here it roughly follows the course of the present Wabash River southward to the Ohio River and out to the site of the former Gulf Embayment near the southern tip of Illinois (Fig. 5).

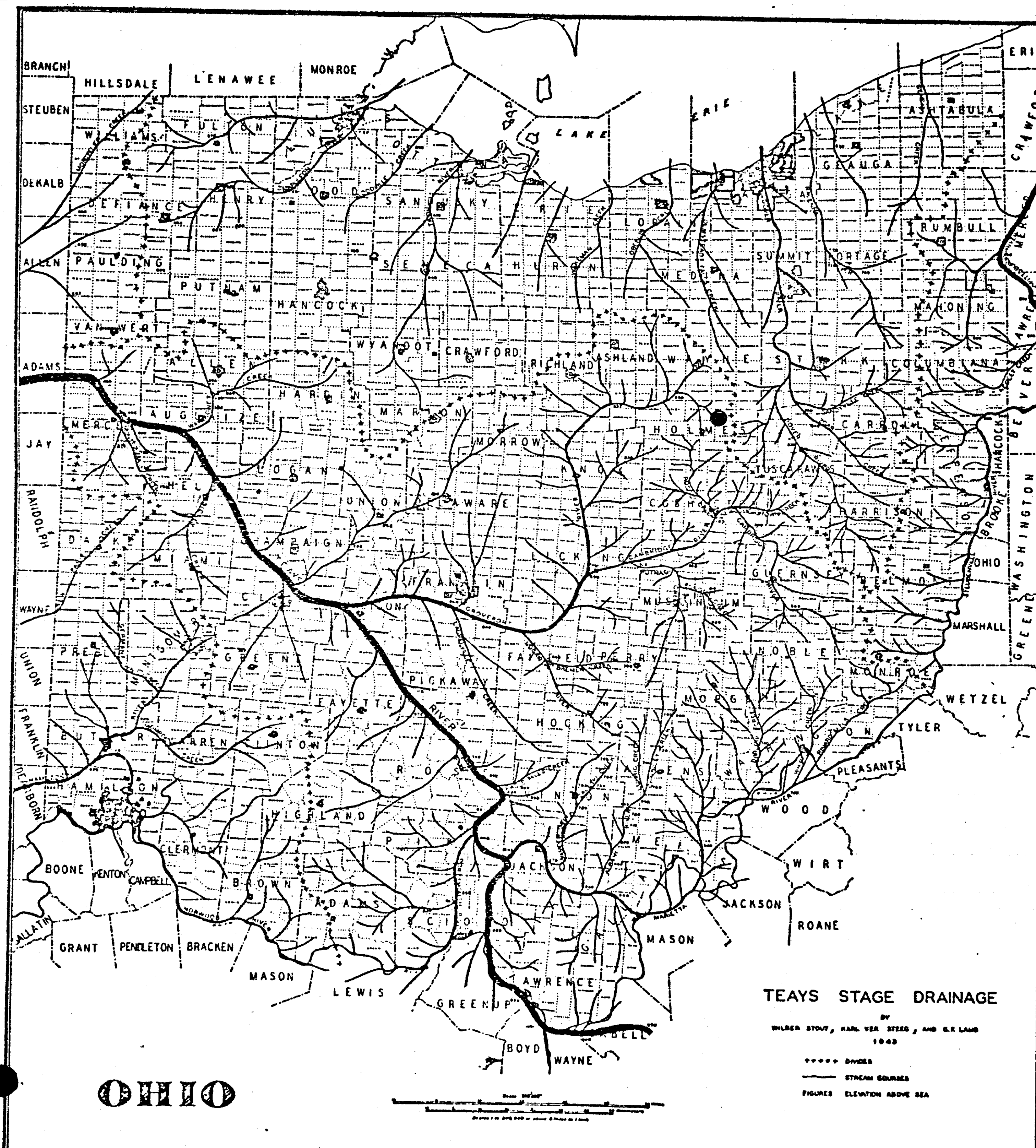


Figure 4

G. R. WASHBURN
DRAFTSMAN

From Bulletin 44, Ohio Division of Geological Survey

Teay's Ohio and Indiana Drainage

(after Fidlar, 1943)

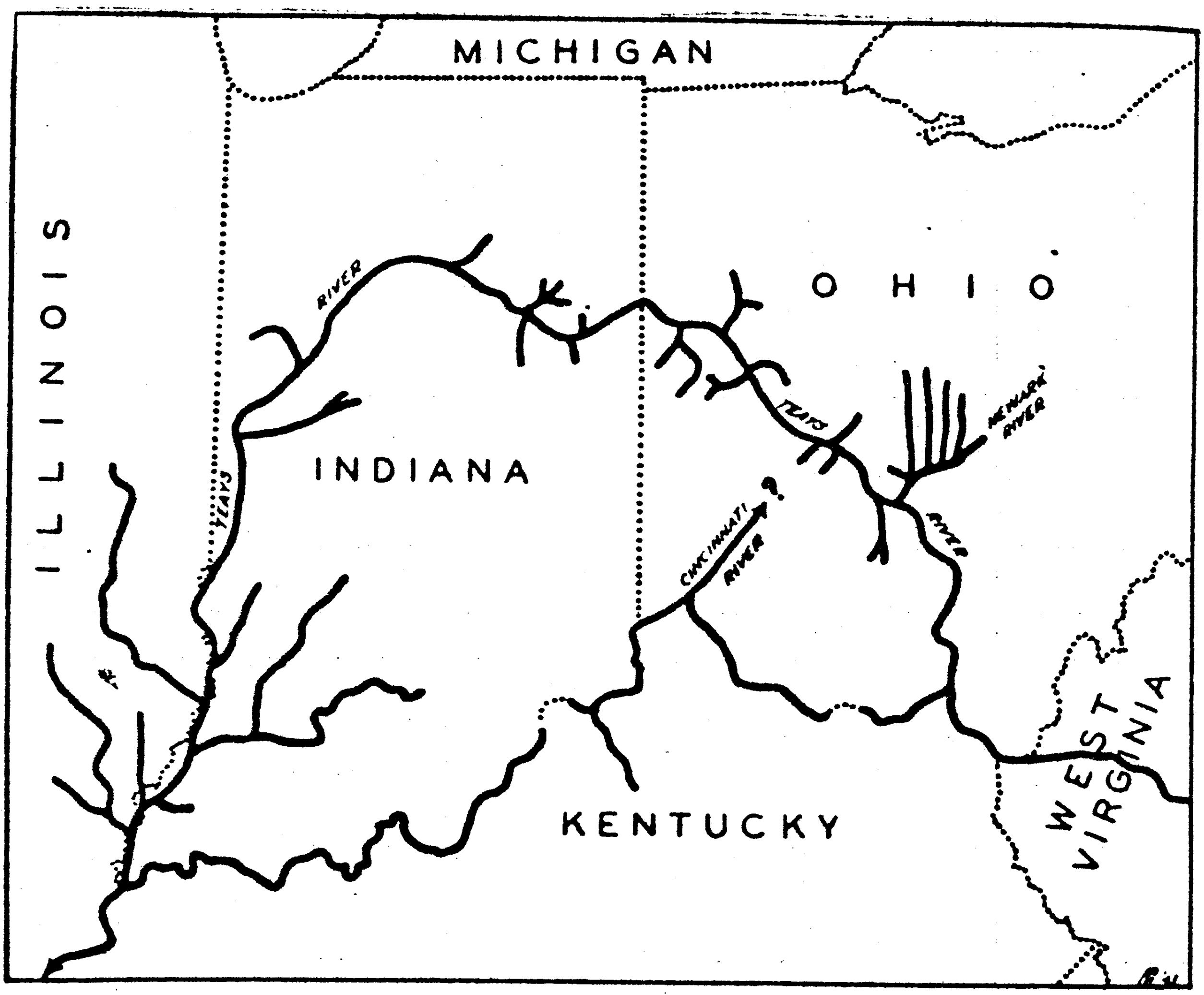


Figure 5

Effects of Glaciation of the Teays

The idea that the course of the Teays River, below its northwest turning point in Pickaway County, is pre-glacial in its origin is not disputed. It is in the areas where its course has been hidden by the thick mantle of glacial drift that the course, and the chronology of events that shaped it, has been most subject to interpretation. Stout, Ver Steeg, Lamb (1943) and others believed the channel they mapped northwest from Pickaway County to Mercer County and the Indiana line was either pre-glacial or interglacial in origin. Because of the lack of data they were unable to establish which was the correct assumption.

Nebraskan Glacier

Coffey (1961), in his article entitled Major Preglacial, Nebraskan, and Kansan Glacial Drainages in Ohio, Indiana, and Illinois, puts forth the hypothesis that the Teays system flowed northward from Chillicothe to the Lake Erie Basin in pre-glacial time. Only due to the advance of the Nebraskan glaciation, he believes, was this course diverted northwestward and formed the channel mapped by Stout, Ver Steeg, and Lamb (ibid). He bases this idea, first of all, on a system of drainage divides that existed in Ohio in pre-glacial time. He has roughly delineated these divides in a map included in his 1958 article (Coffee, 1958) which also indicates the courses of the pre-glacial Teays and inter-glacial Teays channels (Fig. 6). This map is based on contour maps of the bedrock surface of Ohio.

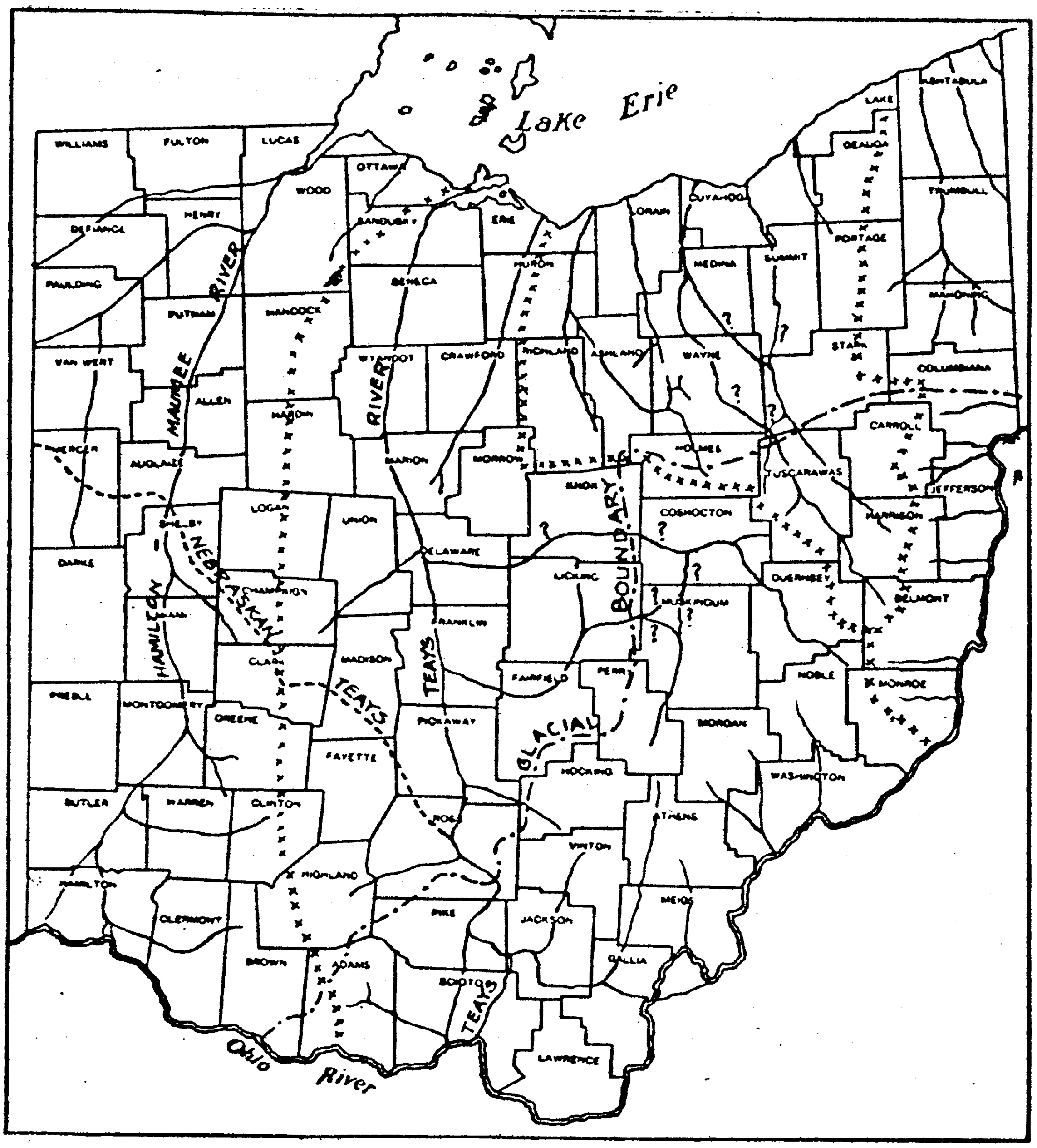


Figure 6

Divides are indicated by XXXX, and streams by ——
Glacial boundary is shown by —·—·—·— and
the interglacial Nebraskan-Teays River by — — — — —

Further, he believes the path of the Nebraskan glacier was southward from the northeast along the Lake Erie Basin. As the glacier moved slowly southward at a rate which Goldthwait estimates "at fastest known speed took 5,000 years to cross the state the first time," it blocked all the north flowing streams in its path which forced them to seek new outlets or to form lakes. As the glacier advanced south to Central Ohio, it blocked the northward flow of the Hamilton-Maumee River (Fig. 6). This blockage of the Teays resulted in the formation of a lake in the present Scioto Valley. The lake continued rising until it broke over the western divide in Clark County, joined with the Hamilton-Maumee drainage, and continued on northwestward into Indiana.

He uses as further evidence that the pre-glacial Teays flowed northward to the Lake Erie Basin, the following reasoning (Coffee, 1958, p. 299):

> The present Scioto Valley, and northward to Lake Erie, is underlain by the Devonian geological formation, which evidently was easily eroded. It would certainly seem more natural for the old Teays River to have extended northward to Lake Erie and to have been primarily responsible for the formation of the broad Scioto Valley rather than to have turned northwestward on what, if true, would have been the divide between the Great Lakes and the Gulf drainage.

The width of the Scioto Valley is much greater than the northwest valley of the Teays. This was further proof to him that the later valley was much younger than the Scioto.

Kansan Glacier

Following the Nebraskan glaciation, the Aftonian interglacial occurred. This interglacial period was very long, at least 100,000 years and probably much longer (Flint, 1957). During this time the Teays flowed in its northwest trending channel from Chillicothe to the Indiana border adjoining Mercer County. It was a very large stream, draining much glacial meltwater, and also much of Southern Ohio, Kentucky, West Virginia and Tennessee. With the arrival of the Kansan Glaciation, the Teays channel was dammed by the glacial front. This ponding resulted in the formation of large finger lakes in which were deposited the Minford Silts to a thickness of 80 feet (Ver Steeg, 1946). The ponded area extended as far north as northern Ross and Athens Counties, as far west as the Licking Valley of Kentucky, as far east as the present Kanawha River in West Virginia, and 40 or 50 miles south of the site of the present Ohio River (Ver Steeg, ibid). The accumulations of silts and sand on the lake bottoms filled all of the former river valleys and the surrounding topography. When the lake drained many of the rivers did not return to their former courses, cutting new outlets to the Ohio River. The retreat of the Kansan Glaciation brought on a new system of drainage, the "Deep Stage".

Deep Stage

While the Kansan blocked the northward path of the Teays and its tributaries, the huge lake system which resulted continued to grow. Eventually it grew to an elevation sufficient to cause stream reversal and downcutting in the area of the Ohio River. This new stage of drainage in Ohio's history is now referred to as the Deep Stage, because of the depth to which it cut a new channel below the floor of the old Teays (Fig. 7). The Deep Stage persisted throughout the Yarmouth interglacial but was eventually buried by the Illinoian Glacier.

Illinoian and Wisconsin Glaciers

Much is known of the extent and effects of these two most recent glacial advances. As far as Teays drainage is concerned, however, they had little bearing on its long since filled in channels. The Illinoian did have a major effect on Deep Stage drainage. Those former deep channels are now filled to a depth of more than 250 feet, in some places, with glacial till and outwash deposits. Post-Illinoian Stage drainage was mapped by Stout, Ver Steeg, and Lamb (1943) and their map is Figure 8.

Bedrock Topographic Map of Scioto Township, Pickaway County, Ohio

I prepared the bedrock topographic map of Scioto Township (Plate 1) during February and March of 1983. Prior to this the only other recent bedrock mapping done that has mapped any of Pickaway County is a report entitled Ground Water for Industry in the Scioto River Valley by the Ohio Division of Natural Resources, Division of Water, published in 1965. It was planned as the first in a series of buried

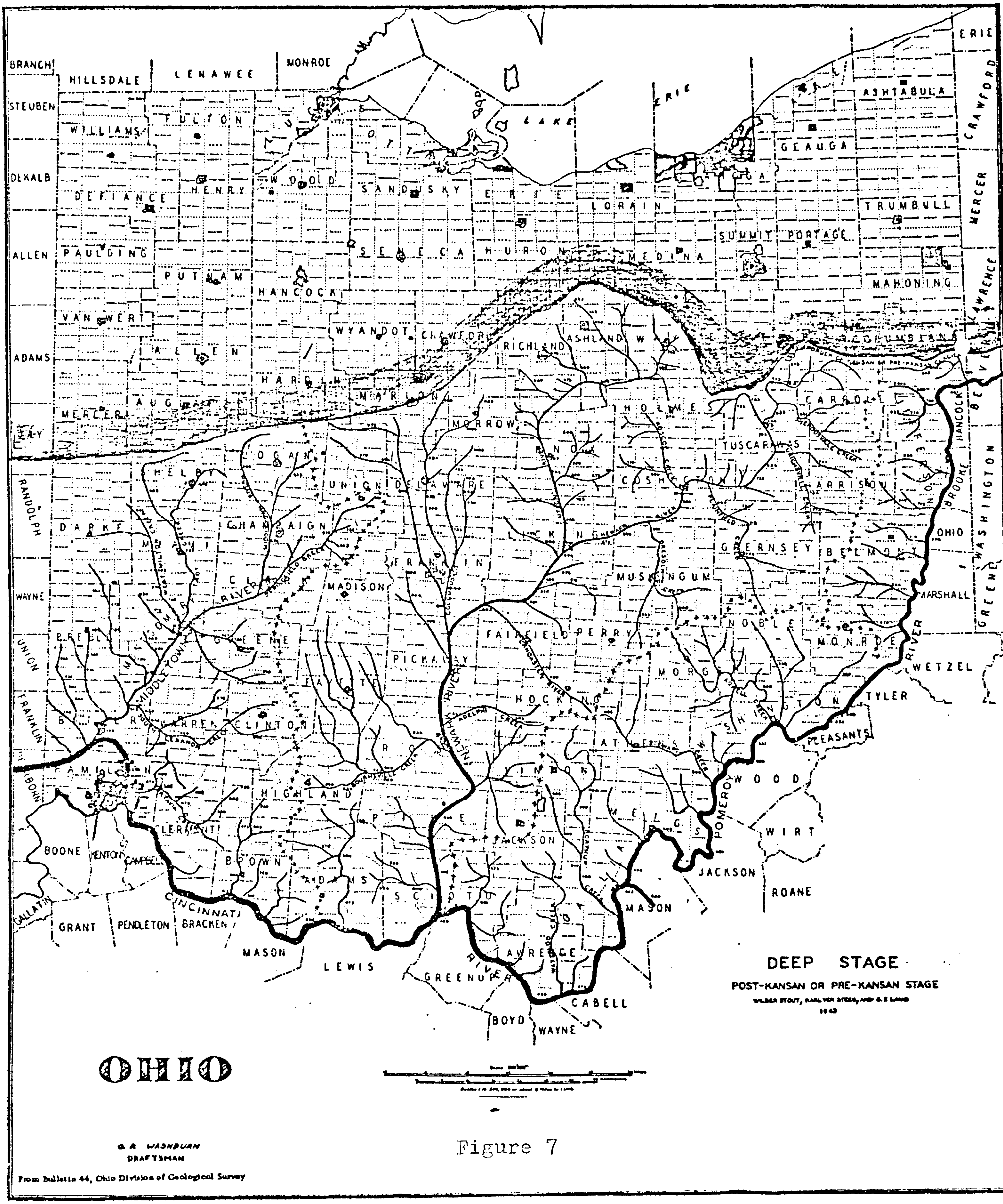
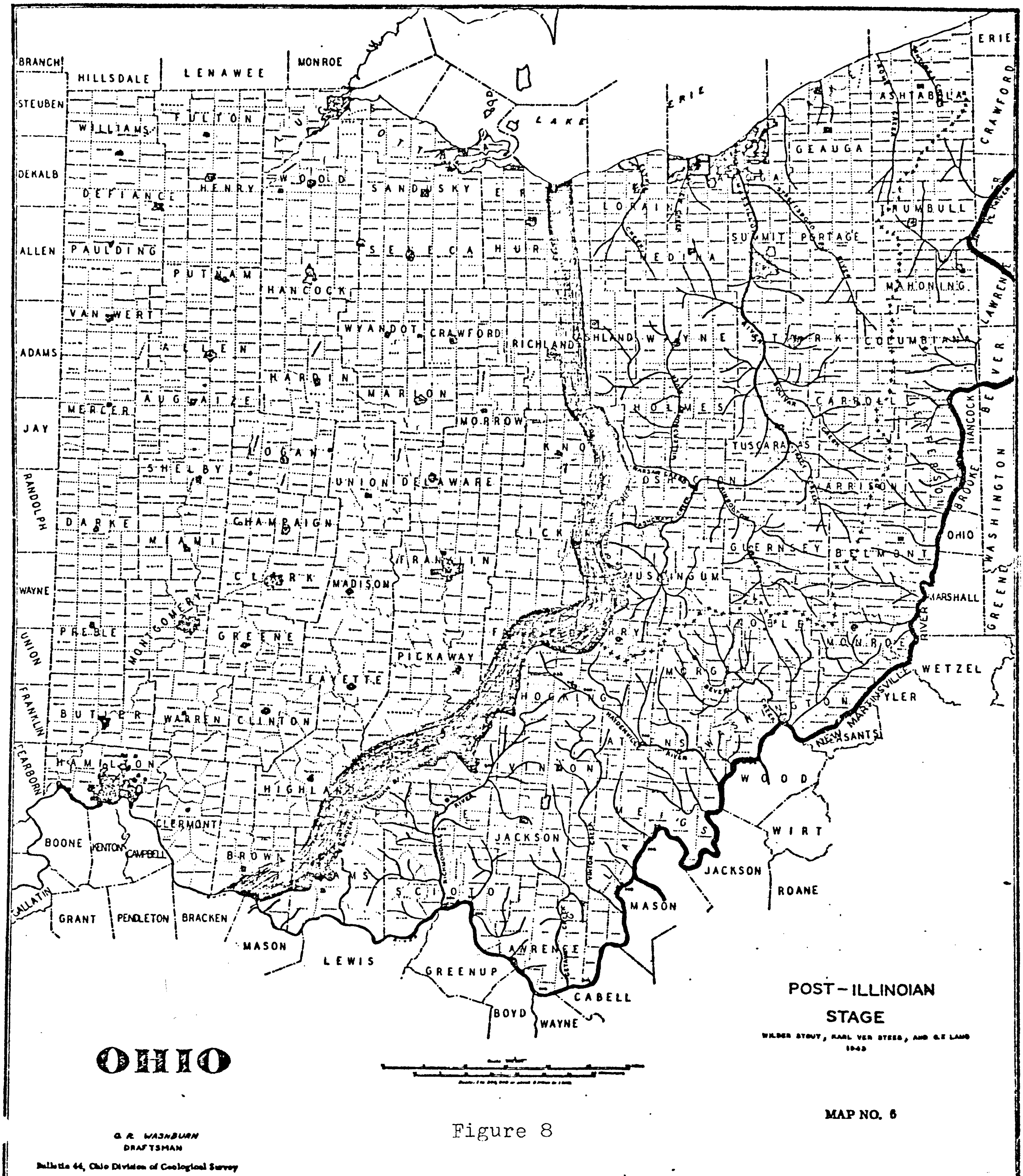

DEEP STAGE
POST-KANSAN OR PRE-KANSAN STAGE
OHIO
G. R. WASHBURN
DRAFTSMAN
From Bulletin 44, Ohio Division of Geological Survey

Figure 7



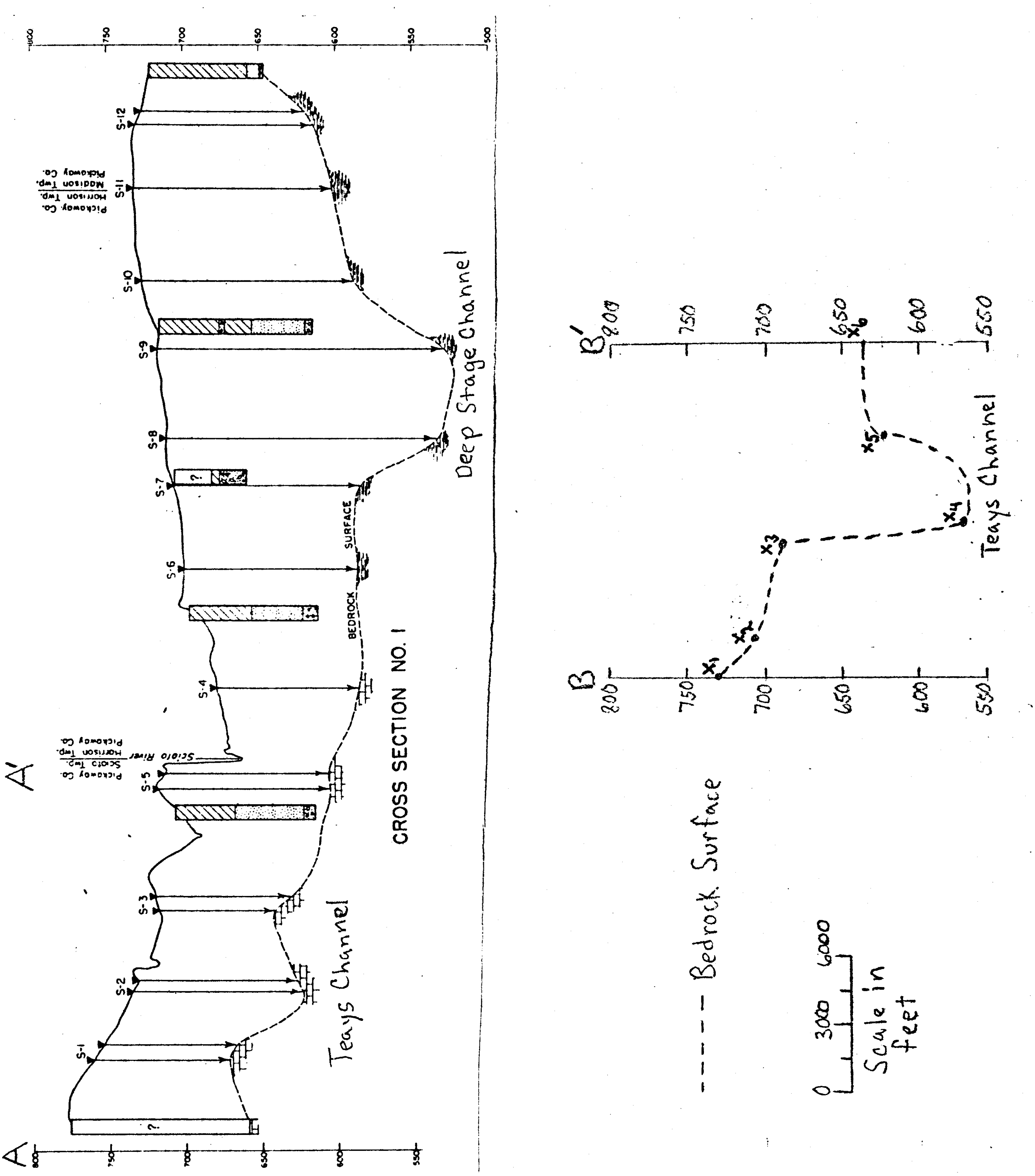
OHIO
POST-ILLINOIAN STAGE
MAP NO. 6
G. R. WASHBURN DRAFTSMAN
Bulletin 44, Ohio Division of Geological Survey

Figure 8

valley investigations that proposed to map the larger of Ohio's buried valleys using existing well records, test wells in key locations, and seismic refraction, in order to increase knowledge of Ohio's ground water resources (these buried valleys being a potentially large source of groundwater). Sadly, that report has so far been the first and only of its kind published by the Division of Water. It served as inspiration for choosing Scioto Township as my map area. The buried valley report indicates, in the northwest section of plate 1-a of that report, that the Teays River, or possibly a tributary, flowed northwest across Scioto Township. The data on this map includes only a small portion of Scioto Township itself. Scioto Township then seemed ideal for the undertaking of a project involving the mapping of bedrock topography that would yield good results and possibly clearly show a buried channel. Though many surrounding counties have had bedrock topographic maps prepared, Pickaway County has not. This also proved fortunate for my map of Scioto Township in that this map is somewhat unique.

In preparing the topographic map of Scioto Township (Plate 1), well logs supplied by the Ohio Division of Water were used almost exclusively. Of the hundreds of well logs on file for Scioto Township, roughly one-eighth of them indicated depth to bedrock. This depth was then subtracted from the current elevations at their locations to yield the elevation of the underlying bedrock. To supplement this data, many deep wells that did not reach bedrock were also plotted on the map to further aid its drawing. In addition to this, a number of seismic shots had been done in eastern Scioto Township by the preparers of the Buried Valley Report; these were also used.

Included with the Buried Valley Investigation by the Division of Water are a number of cross-sections done from data collected by seismic refraction methods. One of these is shown in Figure 9. It is the cross-section A-A', shown on Plate 1. The entire cross-section is not represented on Plate 1, however, only the section of it inside of Scioto Township (seismic shots 1-4) is on this map. These four shots delineate the path of the Teays entering the Township. Figure 10 is the cross-section B-B' showing the Teays channel flowing across Scioto Township. The true depth of the channel, basing my assumptions on the bedrock map of the Madison County, may be somewhat deeper than available data indicates. Therefore, on this cross-section, I have drawn in what I project to be the approximate shape of the channel.



Cross Sections A-A' and B-B'

figure 9

Conclusions

The correct path of the Teays, in pre-glacial and interglacial time, has long been debated. Upon the completion of this report, I feel nothing short of a complete seismic study of the entire area covered by till will satisfy everyone as to the exact paths of the system. Even this may raise more questions than it answers. Unfortunately, in many parts of my study area, and probably in much of the glaciated areas, additional data in the form of well logs to bedrock, will be slow in coming. The sparse population of much of the area, and the fact that sufficient water can often be obtained without the expense of drilling to bedrock, restricts the number of bedrock wells in many areas where they are needed most to delineate the Teays. However, with new techniques and more wells drilled, more and more will become apparent in future studies.

As to my study area, it is hard to say whether or not the southeast to northwest channel trending across Scioto is indeed the interglacial Teays Valley. Along much of it , it has the proper depth to have been that stream, and it correlates well with both Buried Valley Investigation and the Bedrock Topographic Map of Madison County by the Ohio Division of Water. If it is, then it shows that the map by Stout, Ver Steeg, and Lamb is indeed very generalized, having projected the northwest path of the Teays beginning much more to the south of Scioto Township in Pickaway County.

On Plate 1 I have marked, with dashed lines, what I believe to be the approximate path of the Teays River crossing the Township. From the bedrock contours it is clear that the channel was steep-banked and averaged between one-half and three-quarters of a mile wide. It crosses the township entering from the southeast corner of Scioto and leaving just south of the northwest corner of the township under Orient State Institute.

The value of knowing the general path of abandoned stream channels, especially those buried by glacial drift, can be enormous. Abandoned channels filled with coarse sand and gravel have proven to be prolific sources of groundwater in many areas. If wells drilled into these buried valleys prove their worth as groundwater resevoirs, they could help attract industry to the area.

Not all buried ~~ac~~quifers yield sufficient supplies of groundwater. In Scioto Township, Stout, Ver Steeg, and Lamb (1943) reported that many of the areas buried stream channels are very poor sources of groundwater, yielding only enough for individual home use. The reason for this is that the channels were filled with fine sands and clays when the Teays was dammed by a glacial advance. Clays are very impermeable and act to retard groundwater flow. Fine sand deposits are poor aquifers because it is often difficult if not impossible to develop a well drilled into unconsolidated fine sand. Pumping the well yields large amounts of fine sand with the groundwater which in turn damages pumping equipment.

A map of this type is a valuable aid to state and local agencies searching for additional water supplies. A well planned and systematic study of the areas water resources must begin with first outlining the locations of potential aquifers and then analyzing their various characteristics. This map is the first step in that process.

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